Environmentally Friendly Novel Routes for the Transportation Fuel

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IMPROVEMENT IN VEHICLE TECHNOLOGY

- Gasoline Hybrid Electric Vehicles (GHEVs) have 45% higher fuel economy than Internal Combustion Engine (ICE) vehicles
- 1.1 billion ton biomass can meet need for US transportation
- Plug-in Hybrid Electric Vehicles (PHEVs) rechargeable batteries = short range
- Liquid fuel = long range

RESULTS

Production of 13.8 Mbbld of synthetic oil using Biomass

<table>
<thead>
<tr>
<th>Case</th>
<th>Gasifier Efficiency (%)</th>
<th>Biomass Land area (million km²)</th>
<th>Required H₂ (Billion kgl/yr)</th>
<th>H₂ Land area (million km²)</th>
<th>Energy Efficiency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional - I</td>
<td>50</td>
<td>5.30</td>
<td>0</td>
<td>0</td>
<td>26.2</td>
</tr>
<tr>
<td>Conventional - II</td>
<td>70</td>
<td>2.51</td>
<td>0</td>
<td>0</td>
<td>36.7</td>
</tr>
<tr>
<td>H₂CAR - I</td>
<td>50</td>
<td>1.41</td>
<td>276</td>
<td>0.062</td>
<td>-100</td>
</tr>
<tr>
<td>H₂CAR - II</td>
<td>70</td>
<td>0.92</td>
<td>239</td>
<td>0.054</td>
<td>-100</td>
</tr>
</tbody>
</table>

US transportation oil consumption = 13.8 Mbbld
US land area = 9.2 million km²

Production of 13.8 Mbbld of synthetic oil using Coal

<table>
<thead>
<tr>
<th>Case</th>
<th>Amt of Coal (Billion tons/yr)</th>
<th>Required H₂ (Billion kgl/yr)</th>
<th>CO₂ Sequestered (GtC/yr)</th>
<th>Carbon Efficiency (%)</th>
<th>Energy Efficiency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional</td>
<td>1.97</td>
<td>211</td>
<td>0</td>
<td>39.9</td>
<td>60.7</td>
</tr>
<tr>
<td>H₂CAR</td>
<td>0.79</td>
<td>211</td>
<td>0.062</td>
<td>~100</td>
<td>65.2</td>
</tr>
</tbody>
</table>

ADVANTAGES OF H₂CAR™ PROCESS

- No CO₂ emission from the chemical processing system
- Higher energy efficiency compared to conventional process
- Existing infrastructure can be used

SYNERGY BETWEEN THERMOCHEMICAL AND BIOLOGICAL PROCESSES

Micro-organisms based processes produce one pound of CO₂ per pound of ethanol and need heat for distillation. On the other hand, H₂CAR process can consume CO₂ and produce liquid fuel and liberates heat which can be used for distillation in the micro-organisms based processes.

IN A NUTSHELL...

- Significant results
  - Overall energy efficiency of the integrated process improves from 57% to 65%
  - Ethanol life cycle energy balance improves from 1.25 to 3.32 without any CO₂ release

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REFERENCE